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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A62C 31/07 — A1

(11) International Publication Number: **WO 99/32194**

(43) International Publication Date: 1 July 1999 (01.07.99)

(21) International Application Number: PCT/DK98/00568

(22) International Filing Date: 18 December 1998 (18.12.98)

(30) Priority Data:
1496/97 19 December 1997 (19.12.97) DK

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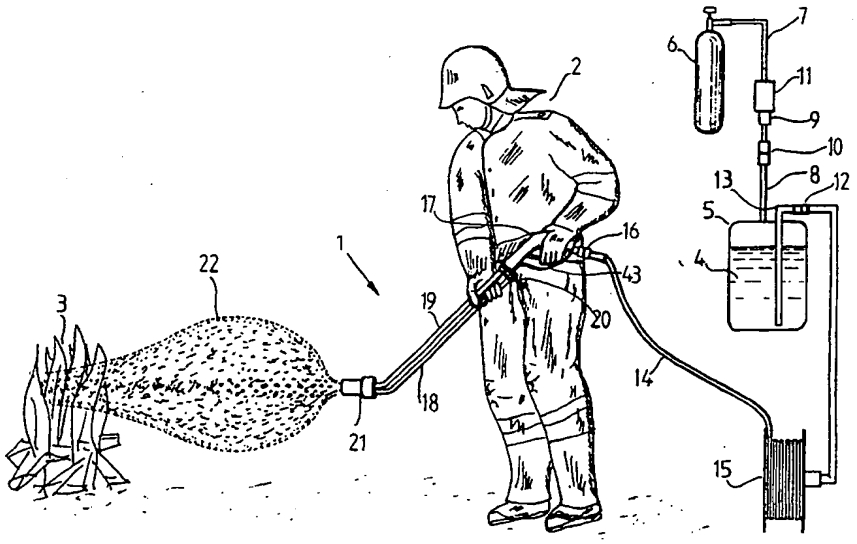
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
With amended claims.
In English translation (filed in Danish).

(54) Title: A FIRE EXTINGUISHING DEVICE



(57) Abstract

The invention relates to a fire extinguishing device (1) of the kind which comprises at least one liquid conduit connected at one end to a source with a fire extinguishing liquid under pressure, and at the other end with channels (40, 23) in a nozzle head (21) with a number of nozzles (24, 27). The channels of the nozzle head comprise a first channel (40) connected to at least one atomising nozzle (27) for discharging liquid in atomised form, and a second channel (23) which has an air intake (25) and downstrean of this is connected to a foam nozzle (24) for discharging a liquid in foamed form. The device can be utilised for effectively extinguishing class A, B, C, and E fires and can, with one single handle, be converted to fighting fires with either foam or water. The water can be atomised to a very high fineness by means of a relatively slight pressure of about 10 – 25 bar, and a range of over 10 metres is obtained. Far less water is used for extinguishing a fire than when using conventional fire extinguishing equipment.

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A fire extinguishing device

The invention relates to a fire extinguishing device of the kind which comprises at least one liquid conduit, and which at one end is connected to a source with a fire extinguishing liquid under pressure, and at the other end with channels in a nozzle head with a number of nozzles.

It is a well-known fact that water in its plain state is not a very effective means for extinguishing a fire as up to 98% of the water will not take part in the extinguishing but in stead slide of the burning objects without ever reaching the primary combustion. If fire has broken out in particularly inflammable liquids, such as gasoline, spraying with plain water can on the contrary result in a spreading of the fire.

The water is better utilised when it is carried in the form of small drops. However, an optimum utilisation is only obtained with finely atomised water which has a very large total surface and evaporates immediately when it is sprayed into areas where a combustion is taking place at a high temperature.

The last-mentioned effect is extremely desirable as the smoke gases from the fire are cooled momentarily just as the violent vapour formation also displaces the combustible gases and reduces the oxygen content of the air.

During a fire, air will flow to the primary combustion zone where the oxygen content of the air will feed the combustion. However, the fine water drops are so small and have a mass so small that they will tend to drift in the air and by this be taken into the combustion zone where the combustion thereby is impeded or stopped altogether.

Finely atomised water will also be able to penetrate fibrous material and thereby advantageously be able to reduce its

combustibility while small drops merely will remain on the surface of the material.

In a cloud of finely atomised water, the drops will furthermore be so small and have a mutual distance so large that the electric conductivity of the cloud will be very small. Finely atomised water can therefore be utilised with minimal risk for the operator even if there are live wires at the scene of the fire.

Conventionally, pressures as high as between 150 and 250 bar have been utilised in order to atomise water finely enough for the fighting of a fire. However, the high pressures require heavy equipment which normally only can be established in stationary and/or large units.

Such heavy equipment cannot or only with difficulty be utilised for offensive fire fighting, and the formed finely atomised water has furthermore turned out to have a range too short to be able to adequately prevent the fire fighters being injured by the heat sent out by the fire.

For quick and effective extinguishing of fluid fires (class B fire) and securing against reignition, it can be necessary to utilise foam which forms a stable carpet of small bubbles for effectively cooling and smothering fires that are difficult to control in any other way.

At fire turn-outs, it will not always immediately be clear if the fire in question is a class A, B, C, or E fire. This means that it, at the time of the turn-out, can be uncertain whether it is one type of fire extinguishing equipment or the other that would be most effective in the given situation, and that therefore should be brought along. It is therefore an advantage if both finely atomised water and foam can be discharged from the same fire extinguishing device so that the choice between foam or finely atomised water as fire extinguishing means only

need being made when the fire brigade has arrived at the scene of the fire.

It is furthermore an advantage if the quantity of fire extinguishing means necessary for extinguishing a fire is as small as possible so that the fire extinguishing device is not restricted to stationary use but can also be utilised offensively.

A combined fire extinguishing device is among others disclosed in US Patent 2,832,242. This device can, with a valve, be converted to discharge either atomised water or foam but from the same nozzle type. A nozzle for foam can however not be utilised for finely atomising of water. The drops in the atomised water, which the conventional fire extinguishing device is able to discharge, will therefore be too coarse to optimally be able to fight a fire.

US Patent 4,420,047 discloses a similar fire extinguishing device for fitting in aircraft. The device can selectively discharge either foam or atomised water but also in this case, from the same nozzle type. This device is not able to fight a fire by means of finely atomised water either.

The object of the invention is to provide a fire extinguishing device of the kind mentioned in the opening paragraph wherewith class A, B, C, and E fires can optimally be fought, that with one single handle can be converted to fighting fires either with foam or water, and that is able to finely atomise water by means of a relatively slight pressure of about 10 - 25 bar and discharge the finely atomised water with a horizontal range of over 10 metres.

This is according to the invention achieved by the fact that the channels of the nozzle head comprise a first channel connected to an atomising nozzle for discharging liquid in atomised form, and a second channel which has an air intake and downstream of

this is connected to a foam nozzle for discharging liquid in foamed form.

In a preferred embodiment of the invention, the liquid conduit of the fire extinguishing device can have a first branch connected to the first channel of the nozzle head, and a second branch connected to the second channel of the nozzle head. This construction is especially simple to manufacture.

At the branch point, there can furthermore be placed a reversing valve for selectively closing the first or the second channel completely or partly so that there, with a single handle, easily and quickly can be changed between discharging of foam and discharging of finely atomised water.

Operation of the fire extinguishing device is facilitated when there in the liquid conduit is inserted a flow gun with a gun valve for turning the liquid on and off respectively.

In each of the atomising nozzles of the fire extinguishing device, there can, at a distance from the nozzle opening, advantageously be placed a partition wall extending transversely to the inner side of the nozzle and together with this defining a nozzle chamber. In the partition wall, a central opening and at least one side opening can furthermore be made. When the fire extinguishing device is utilised for fire fighting with atomised water, a finely atomised water cone is then discharged via the nozzle opening, which water cone is filled in with larger water drops for carrying the finely atomised water with it and thereby increase the range of this considerably.

A number of atomising nozzles can advantageously be placed at a mutual distance along a circle in the end cover of the nozzle head whereby the device is enabled to discharge a relatively large quantity of atomised water in a joint bundle.

When the central openings of the atomising nozzles furthermore are arranged with different sizes, a bundle of atomised water with degrees of atomisation that advantageously cover a broad spectrum is obtained.

By placing the foam nozzle at or near the centre of the circle along which the atomising nozzles are placed, it is obtained that foam and atomised water are discharged along the same axis so that the operator easily can change between the two extinguishing means without directly having to alter the axial orientation of the nozzle head.

The invention will be explained in greater detail below, describing an embodiment by way of example only with reference to the drawing, in which

Fig. 1 shows an operator extinguishing a fire by means of a fire extinguishing device according to the invention,

Fig. 2 is an axial sectional view of a nozzle head for the fire extinguishing device in fig. 1,

Fig. 3 is an end view of the nozzle head,

Fig. 4 is a sectional view taken along the line IV - IV of fig. 2,

Fig. 5 is on a larger scale a fractional view of the nozzle head in fig. 2, and

Fig. 6 is a sectional view taken along the line VI - VI of fig. 5.

Water means in the following water that has been added a foaming agent. Foam means in the following a foam that is made of water which has been added a foaming agent and foamed with air.

Fig. 1 shows schematically an operator 2 who is extinguishing a fire 3 by means of a fire extinguishing device designated generally by the reference numeral 1.

The fire extinguishing liquid 4 is kept in a tank 5 which via gas conduits 7 and 8 is connected to a pressure bottle 6 containing a pressure gas for keeping the fire extinguishing liquid under a pressure of e.g. 10 - 20 bar. In the gas conduit 7 is inserted a pressure regulating valve 11 for regulating the pressure in the tank 5 and a non-return valve 9 for preventing back flow in the gas conduits.

In the gas conduit 8 is furthermore inserted a quick-release coupling 10 for quickly and easily assembling and disassembling the tank 5 and the pressure bottle 6. A similar quick-release coupling 12 is inserted between a liquid conduit 13 extending down into the fire extinguishing liquid 4 in the tank 5 and a liquid conduit 14 for carrying the fire extinguishing liquid 4 to the rest of the fire extinguishing device.

The length of the liquid conduit 14 is such that it ensures the operator a sufficiently large range during the fire fighting. In order to avoid that the liquid conduit 14 during this gets in the operator's way, it is wound up on a coil 15. The liquid conduit 14 is via a quick-release coupling 16 connected to the inlet end of a flow gun 17 which with a gun valve can turn intake of fire extinguishing liquid 4 on and off.

Downstream of the flow gun 17 is a branch point from where a first branch 18 and a second branch 19 branch off. At the branch point is placed a reversing valve 20 for alternately turning off the first or the second of the two branches 18, 19.

Both branches 18, 19 are furthermore connected to a nozzle head 21 arranged to discharge either finely atomised water or foam. The water for the finely atomised water is supplied via the first branch 18 and the foam via the second branch 19.

Near the nozzle head 21, the branches are bent an angle θ whereby the operator is conveniently enabled to direct the nozzle head on the fire and reach not very accessible areas.

In fig. 1, the first branch 18 is open, and as it can be seen, the fire extinguishing device 1 is then discharging finely atomised water 22.

Fig. 2 is an axial sectional view of the nozzle head 21 on a larger scale. The nozzle head has a first channel 40 connected to the first branch 18 and serving for conducting water to a number of atomising nozzles 27 via a distribution chamber 42.

The nozzle head 21 furthermore has a foam chamber 41 which via a turbulence chamber 44 is connected to the second branch 19 and via air-intake openings 25 to the open. The foam chamber is via a second channel 23 furthermore connected to a foam nozzle 24. When the fire extinguishing device is operating with foam as fire extinguishing means, the water is flowing via the turbulence chamber 44 where the water is set in turbulence into the foam chamber 41 into which air is, via the air-intake openings 25, taken in that foams the turbulent water. The finished foam is carried via the second channel 23 to the foam nozzle 24 and via this out towards the fire.

The nozzle head has an end cover 26 which with a thread 2 is screwed on the end of the nozzle head. The atomising nozzles 27 with the nozzle openings 29 are made in this cover.

Fig. 3 shows the nozzle head 21 seen from the end with a fitted end cover 26, and fig. 4 shows this cover seen from the back. As it can be seen, seven atomising nozzles 27 are placed along a circle. With this arrangement, it is possible to apply a quantity of water sufficiently large for fighting a fire at the same time as the very fine atomisation of the water is

maintained. Fig. 3 also shows that a foam nozzle 24 is placed in between the atomising nozzles 27.

Fig. 5 shows in more detail how an atomising nozzle 27 is arranged. At a distance from the nozzle opening 29, there is by means of a thread 33 detachably placed a partition wall 32 which defines a nozzle chamber 36 in the nozzle. The thread joining makes it possible to quickly and easily remove the partition wall when the respective nozzle is to be inspected or cleaned.

In the side of the partition wall opposite from the nozzle opening is made a relatively deep, transverse groove 30 (fig. 5). Originating from the bottom of this groove, there is in the partition wall 32 made a central opening 31 which flushes with the nozzle opening 29. In the partition wall, there is furthermore made two side openings 34 which originate from each their side of the bottom of the groove 30. Each side opening is communicating with the nozzle chamber 36 via helical grooves 35 made in the periphery of the partition wall 32.

When the gun valve 43 is activated and the reversing valve 20 is set so that the first branch 18 is open and the second branch 19 is closed, water under pressure is flowing via the first channel 40 into the distribution chamber 42.

Part of this water flows via the central opening 31 of each partition wall 32 into the nozzle chamber 36 of the respective atomising nozzle 27 while the other part flows into the chamber via the side openings 34.

As indicated with vectors in fig. 6, the water continues from the central opening 31 mainly in a central jet 39 towards the nozzle opening 29 in the nozzle chamber 36 while the water from the side openings is set in heavy rotation in a rotating liquid layer 37 on the wall of the nozzle chamber as a result of the passage of the water through the helical grooves 35 in the periphery of the partition wall. The two in this way very

different courses of flow mean that there by interference in the nozzle chamber is made an intermediate layer 38 which at the transition to the rotating liquid layer 37 is rotating considerably and at the transition to the central jet 39 mainly follows its left-hand and right-hand transverse movement towards the nozzle opening 29.

The substantially different flows in the nozzle chamber result in combination in discharging via the nozzle opening of a fan of finely atomised water and more coarsely atomised water which fills in the interior of the cone. The coarser water particles have a relatively great inertia og thereby a long range. During their passage through the air, the coarser water particles generate a negative pressure in the surrounding air. The negative pressure has the effect of carrying the finely atomised water along with the coarsely atomised water in the middle of the cone. Thereby, also the finely atomised water obtains a long range.

When the central openings 31 of the six atomising nozzles furthermore are arranged with different sizes, a bundle of atomised water is obtained with degrees of atomising that advantageously cover a broad spectrum.

Thereby, the discharged finely atomised water jointly obtains an advantageous configuration as the finely atomised water first spreads in the shape of a fan outwards while it later narrows to a smaller diameter as a result of said negative pressure.

Thereby, the finely atomised water at first obtains a great extent which is suitable for protecting the operator against radiant heat from the fire. The subsequent narrowing enables the operator to utilise finely atomised water for a concentrated attack on the fire.

When the gun valve 43 is activated and the reversing valve 20 is set so that the first branch 18 is closed and the second branch

19 is open, water with foaming agent is flowing via the second channel 41 into the foam chamber 41 where air is taken in via the air-intake openings 25. The air foams the water, and the finished foam is carried via the second channel 23 to the foam nozzle 24 and via this out towards the fire.

Example 1

With said gas pressure of 10 - 20 bar, the same fire extinguishing device was utilised with finely atomised water to extinguish a fire in a fully furnished 19 m^2 room. The fire was extinguished in 15 seconds with a water consumption of about 6 litres.

The very small quantity of water that is used for extinguishing a fire by means of a fire extinguishing device according to the invention means that this with a modest quantity of water can be transported by a small vehicle such as e.g. a motorcycle. This will reach the scene of the fire faster than a fire engine even through heavy traffic in a big city.

The fire extinguishing device can also conveniently be placed in a car, on an aircraft, or a boat, and at not very accessible ski resorts, e.g. a snow scooter can be used for transporting the fire extinguishing device to the scene of the fire.

CLAIMS

1. A fire extinguishing device (1) of the kind which comprises at least one liquid conduit (13,14), and which at one end is connected to a source with a fire extinguishing liquid under pressure, and at the other end with channels (40, 23) in a nozzle head (21) with a number of nozzles (24, 27), **characterised** in that the channels of the nozzle head comprise at least one first channel (40) connected to at least one atomising nozzle (27) for discharging liquid in atomised form, and at least one second channel (23) which has at least one air intake (25) and downstream of this is connected to at least one foam nozzle (24) for discharging liquid in foamed form.

2. A fire extinguishing device (1) according to claim 1, **characterised** in that the liquid conduit has a first branch (18) connected to the first channel (40) of the nozzle head (21), and a second branch (19) connected to the second channel (23) of the nozzle head (21), and that at the branch point, a reversing valve (20) is placed for selectively closing the first or the second channel completely or partly.

3. A fire extinguishing device (1) according to claim 1 or 2, **characterised** in that at a distance from the nozzle opening (29) of the at least one atomising nozzle (27), a partition wall (32) is placed which is extending transversely to the inner side of the nozzle and together with this defining a nozzle chamber (36), that in the partition wall, a central opening (31) and at least one side opening (34) are made, and that there are means for making the liquid, which in operation is flowing through the at least one side opening, (34) describe a rotary motion in the nozzle chamber (36).

4. A fire extinguishing device (1) according to claim 3, **characterised** in that the means for making the liquid

describe a rotary motion in the nozzle chamber (36) consist of at least one mainly helical groove (35) that along the periphery of the partition wall (32) is extending from the at least one side hole (34) in the nozzle chamber.

5. A fire extinguishing device (1) according to claim 1 - 4, **characterised** in that a number of atomising nozzles (27) are placed with a mutual distance along mainly a circle in an end cover (26) on the nozzle head (21).

6. A fire extinguishing device (1) according to claim 1 - 5, **characterised** in that at least two partition walls (32) of atomising nozzles (27) have central openings (31) of different size.

7. A fire extinguishing device (1) according to claim 3 - 6, **characterised** in that at least one partition wall (32) of an atomising nozzle (27) is without central opening.

8. A fire extinguishing device (1) according to claim 5, 6, or 7, **characterised** in that the foam nozzle (24) is placed at or near the centre of the circle along which the atomising nozzles (27) are placed.

9. A fire extinguishing device (1) according to claim 1 - 8, **characterised** in that at least one atomising nozzle (27) is arranged to discharge atomised fire extinguishing liquid with a substantial content of drops of sizes smaller than 1000 micron.

10. A fire extinguishing device (1) according to claim 2 - 9 and which comprises a, in the liquid conduit inserted, flow gun (17) with a gun valve (43) for turning the liquid on and off respectively, **characterised** in that the branch point of the liquid conduit is placed downstream of the gun, and that the first and the second branch (18, 19) are bent in an obtuse angle near the nozzle head.

AMENDED CLAIMS

[received by the International Bureau on 12 May 1999 (12.05.99);
original claims 1 to 10 replaced by amended claims 1 to 9 (2 pages)]

1. A fire extinguishing device (1) of the kind which comprises at least one liquid conduit (13,14), and which at one end is connected to a source with a fire extinguishing liquid under pressure, and at the other end with channels (40, 23) in a nozzle head (21) with a number of nozzles (24, 27), the channels of the nozzle head comprise at least one first channel (40) connected to at least one atomising nozzle (27) for discharging liquid in atomised form, and at least one second channel (23) which has at least one air intake (25) and downstream of this is connected to at least one foam nozzle (24) for discharging liquid in foamed form **characterised** in that at a distance from a nozzle opening (29) of the at least one atomising nozzle (27), a partition wall (32) is placed which is extending transversely to the inner side of the nozzle and together with this defining a nozzle chamber (36), that in the partition wall, a central opening (31) and at least one side opening (34) are made, and that there are means for making the liquid, which in operation is flowing through the at least one side opening, (34) describe a rotary motion in the nozzle chamber (36).

2. A fire extinguishing device (1) according to claim 1, **characterised** in that the means for making the liquid describe a rotary motion in the nozzle chamber (36) consist of at least one mainly helical groove (35) that along the periphery of the partition wall (32) is extending from the at least one side hole (34) in the nozzle chamber.

3. A fire extinguishing device (1) according to claim 1 or 2, **characterised** in that a number of atomising nozzles (27) are placed with a mutual distance along mainly a circle in an end cover (26) on the nozzle head (21).

4. A fire extinguishing device (1) according to claim 1 - 3, **characterised** in that at least two partition walls (32) of atomising nozzles (27) have central openings (31) of different size.

5. A fire extinguishing device (1) according to claim 1 - 5, **characterised** in that at least one partition wall (32) of an atomising nozzle (27) is without central opening.

6. A fire extinguishing device (1) according to claim 3, 4, or 5, **characterised** in that the foam nozzle (24) is placed at or near the centre of the circle along which the atomising nozzles (27) are placed.

7. A fire extinguishing device (1) according to claim 1 - 6, **characterised** in that at least one atomising nozzle (27) is arranged to discharge atomised fire extinguishing liquid with a substantial content of drops of sizes smaller than 1000 micron.

8. A fire extinguishing device (1) according to claim 1 - 7, **characterised** in that the liquid conduit has a first branch (18) connected to the first channel (40) of the nozzle head (21), and a second branch (19) connected to the second channel (23) of the nozzle head (21), and that at the branch point, a reversing valve (20) is placed for selectively closing the first or the second channel completely or partly.

9. A fire extinguishing device (1) according to claim 8 and which comprises a, in the liquid conduit inserted, flow gun (17) with a gun valve (43) for turning the liquid on and off respectively, **characterised** in that the branch point of the liquid conduit is placed downstream of the gun, and that the first and the second branch (18, 19) are bent in an obtuse angle near the nozzle head.

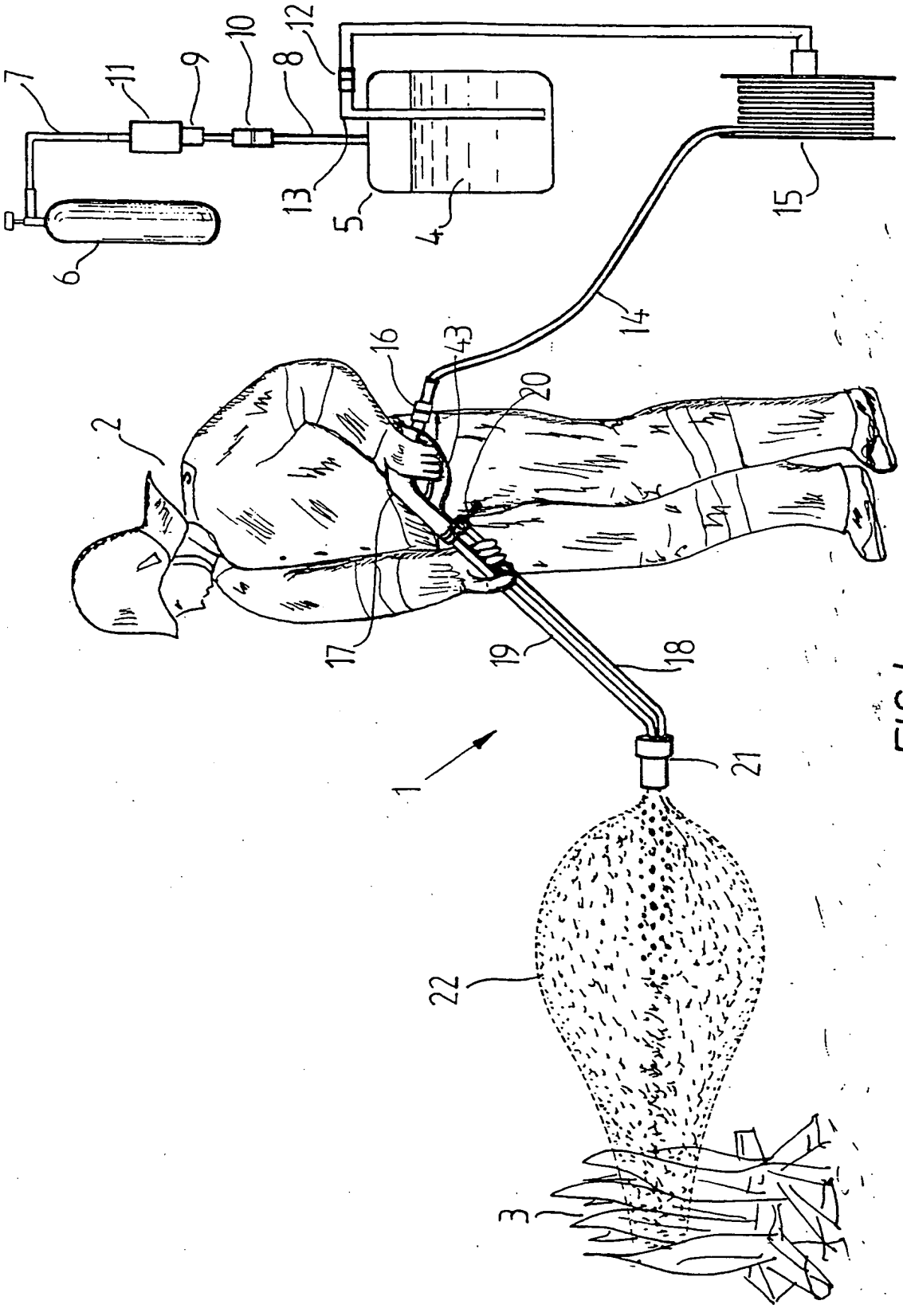


FIG.1

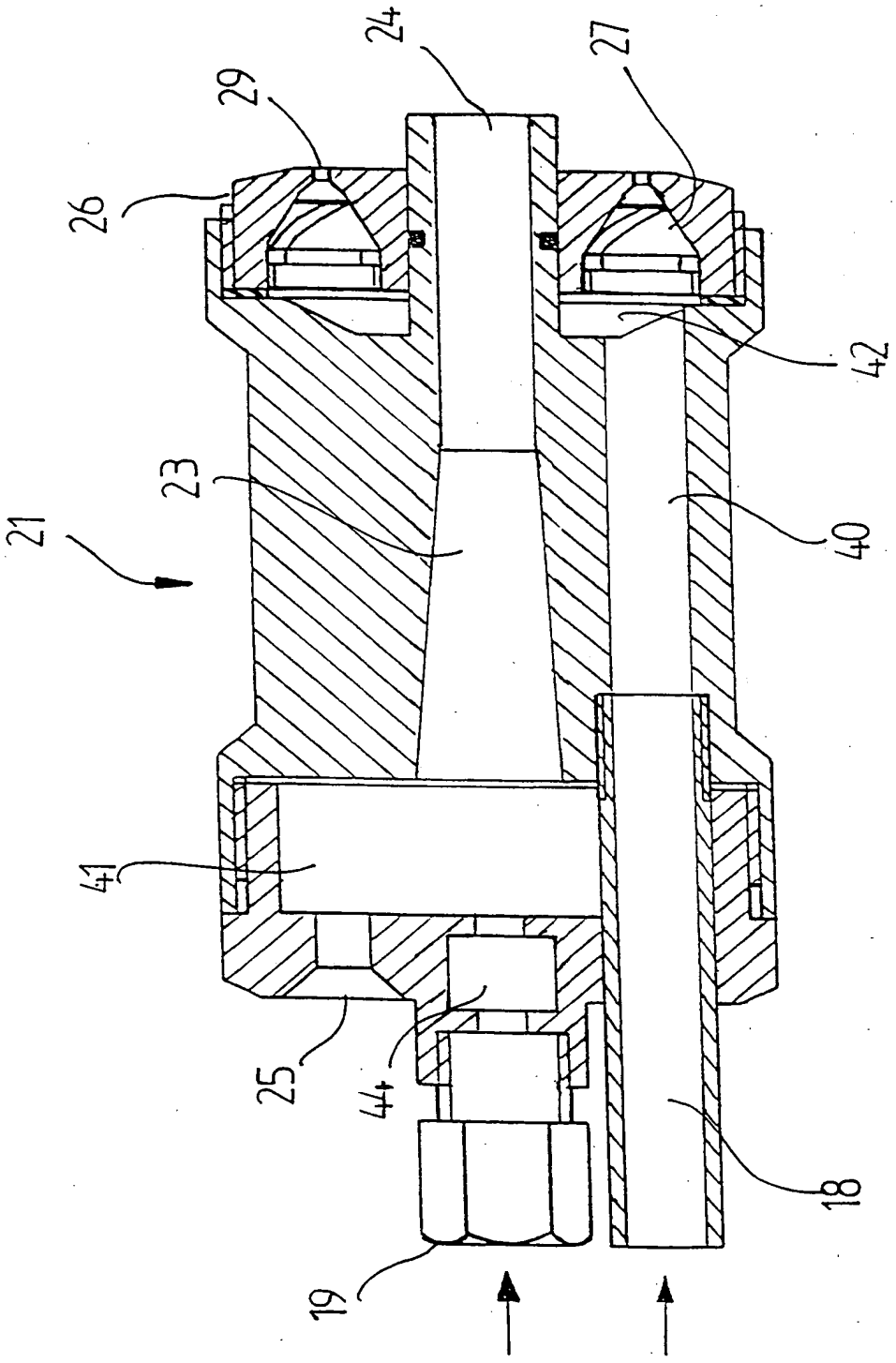


FIG.2

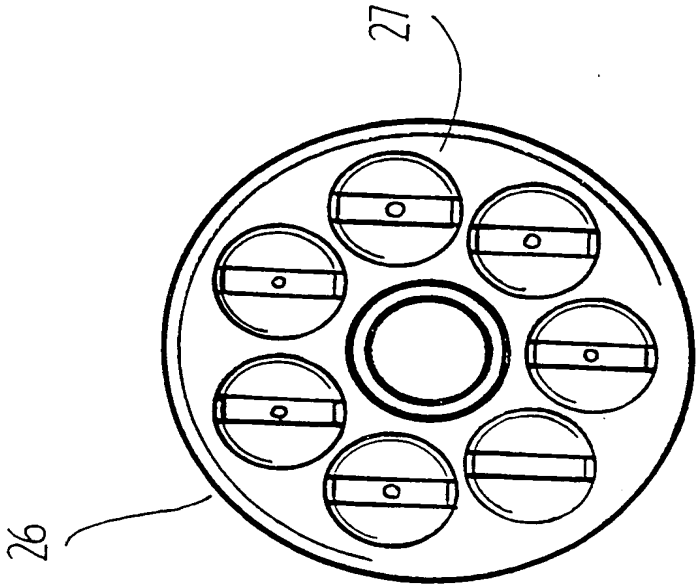


FIG.4

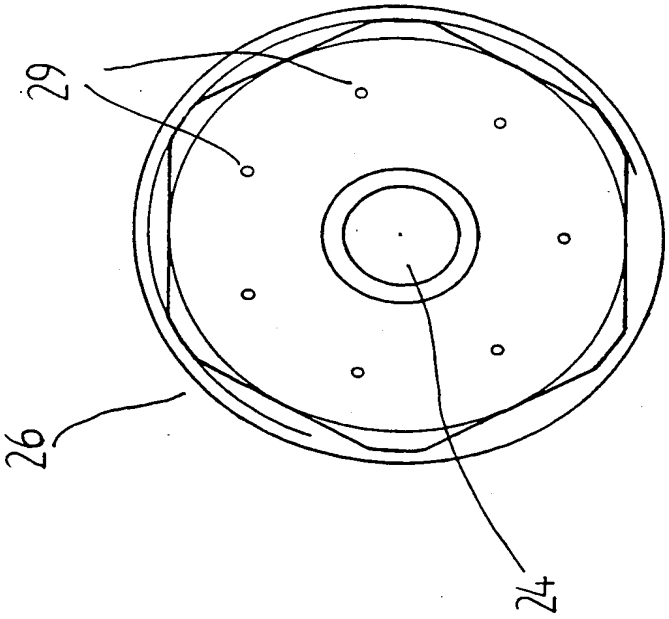
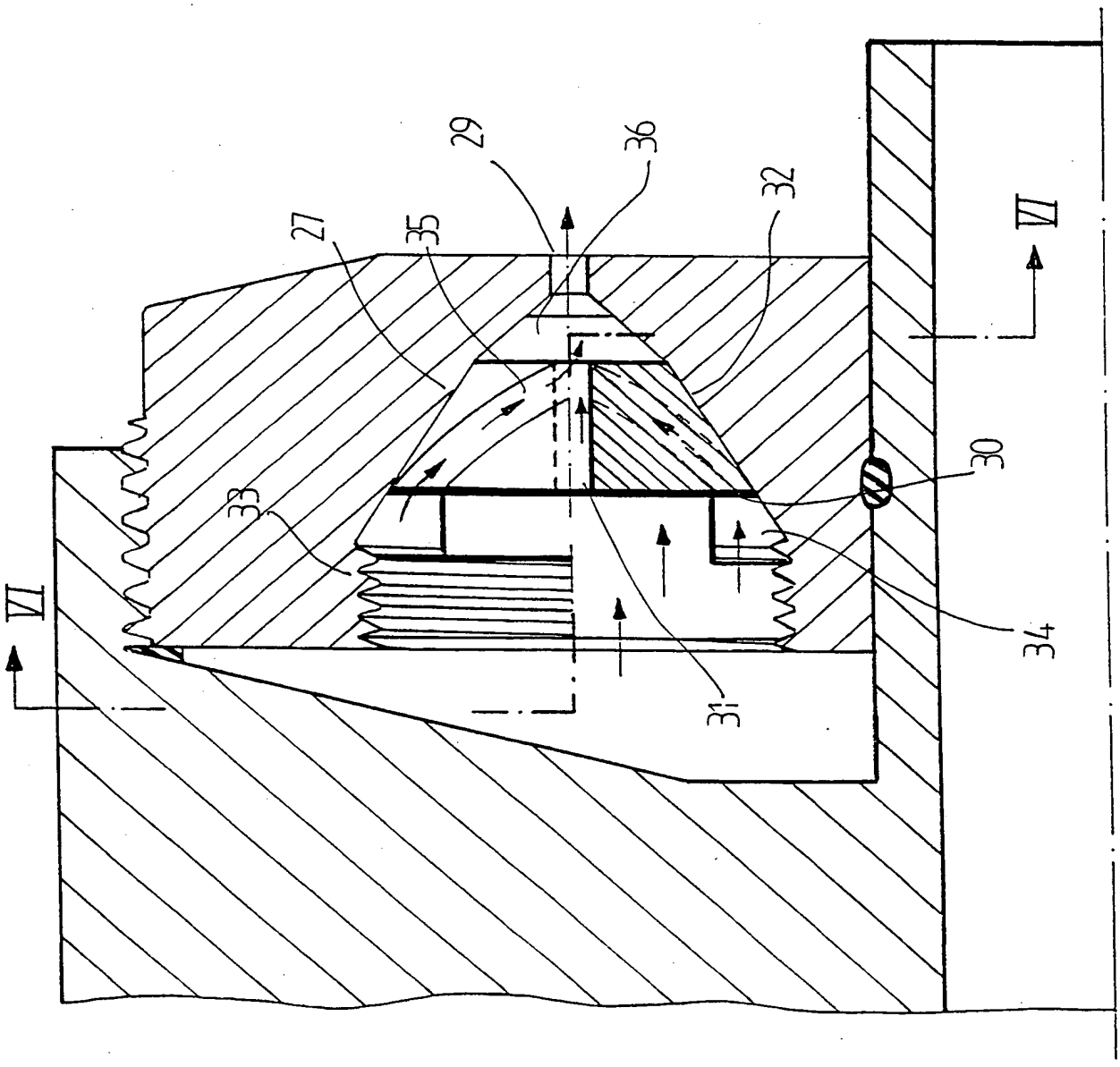


FIG.3

FIG.5



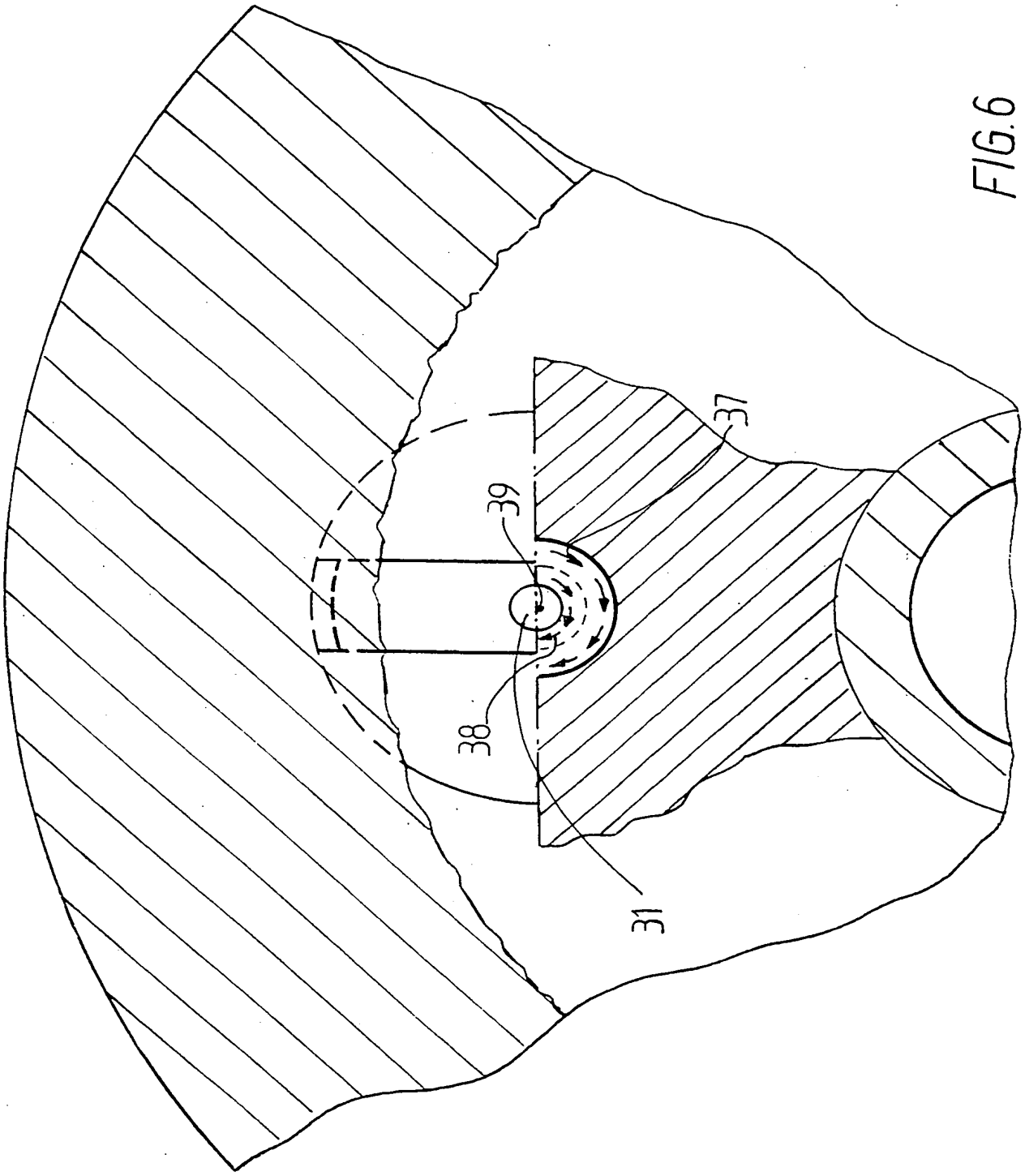


FIG.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 98/00568

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A62C 31/07
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: A62C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EDOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4420047 A (BRUENSICKE), 13 December 1983 (13.12.83), column 2, line 27 - column 4, line 52; column 10, line 6, figure 5, abstract --	1-10
Y	WO 9406517 A1 (SUNDHOLM, GÖSTA), 31 March 1994 (31.03.94), page 1, line 17 - page 16, line 5, figure 8, abstract --	1-10
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Date of the actual completion of the international search
26 March 1999

Date of mailing of the international search report
01 -04- 1999

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